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Effect of different crop establishment methods on yield attributes, yield and economics of basmati rice (*Oryza sativa*) cultivars

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ABSTRACT

A field experiment was conducted during two consecutive *kharif* season of 2009 and 2010 at Zonal Research Station, Nagina, Bijnor to find out performance of 4 basmati rice (*Oryza sativa* L.) varieties (Taraori basmati, Pusa Basmati 1, Pusa Sugandha 4 and Pusa Sugandha 5) under 3 establishment methods (direct seeding, drum seeding and transplanting). Highest values of yield attributes and yield was recorded under transplanting (40.18 q/ha) and in varieties with Pusa Sugandha 5 (42.74 q/ha). Highest cost of cultivation was recorded under transplanting with Pusa Sugandha 5 (₹ 30 594.00) however drum seeding with Pusa Sugandha 5 was prove to be most remunerative combination (₹ 49 119.05). Highest values of B:C ratio (1.97) was also recorded under combination of drum seeding with variety Pusa Sugandha 5.

Key words: Crop establishment method, Direct seeding, Drum seeding, Rice

India is the second largest rice producing country in the world and the crop account for 30-50% of Agricultural income. Rice (*Oryza sativa* L.) is the staple food for more than 65% of the population and also the most important source for meeting the caloric and dietary protein need of the people. Traditional puddle transplanted system of rice cultivation grown with continuous flooding and has required relatively higher water input. To meet out the water crisis head on, valuable gains can be achieved by growing rice with less water. Although transplanting method of establishment has been reported to be best amongst all the factors for high productivity (Singh *et al.* 1997) but keeping in view water crisis and problem of labours during the peak periods of operations some alternatives should be explored. Varieties also performed differently in different planting methods, so it is essential to find out the varieties which performed well in a certain establishment method. Keeping this background in view an attempt was made to find out effect of different crop establishment methods on yield attributes, yield and economics of basmati rice cultivars.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* 2009 and 2010 at Zonal Research Station, Nagina, Bijnor. The soil of experimental site was sandy loam in nature having organic carbon 0.46%, average phosphorus 21 kg/ha, average potash 229 kg/ha and pH 7.7. The experiment was laid out in split plot design and replicated thrice. Main plot comprised 3 crop establishment methods, i e direct seeding, drum seeding and transplanting and sub plots with varieties, viz. Taraori Basmati, Pusa Basmati 1, Pusa Sugandha 4 and Pusa Sugandha 5. The crop was sown on 22 June and 24 June during first and second year, respectively. The crop was fertilized with 120:60:40 kg N, P_2O_5 and K_2O/ha. Other agronomical and other practices were followed as per standard recommendation.

RESULTS AND DISCUSSION

Effect of establishment methods

Growth in vegetative phase and development in reproductive phase determines yield attributes. Highest number of tillers/m^2 was recorded with transplanting (262.16) which was at par with drum seeding (254.91) however highest length of the panicle was found under drum seeding (23.77 cm) which was at par with transplanting (23.63 cm) and both were significantly superior over direct seeding. Highest number of grains/panicle was recorded under transplanting (95.25) which was significantly superior over drum seeding and direct seeding. Similarly highest plant dry weight 777.66 g and test weight 20.41 g was also recorded with transplanting and both showed significantly superior values over drum and direct seeding. Higher values of yield attributes under transplanting might be attributed to comparatively better

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growth and development of plants due to reduced competition for available growth resources. Under this situation, plant received sufficient moisture, light, nutrient and space which might have enhanced better translocation of photosynthates from source to sink. These findings are well supported by Jaiswal and Singh (2001) and Panda *et al.* (1994).

Yield is the function of complex inter relationship of growth in vegetative phase and yield attributes. Highest grain yield was recorded with transplanting (40.18 q/ha) which was significantly superior over drum and direct seeding. Increase in grain was 4.36 and 23.70% higher over drum and direct seeding, respectively (Table 1). Highest straw yield was recorded with transplanting (53.04 q/ha) which was at par with drum seeding (51.67 q/ha), both were significantly superior over direct seeding (42.66 q/ha). Highest grain yield under transplanting was mainly due to better crop growth resulting into higher values of yield attributes which increased the grain yield while higher straw yield was probably due to more dry matter production/unit area. These findings are in agreement with those of Goel and Verma (2000) and Yadav *et al.* (2005).

Effect of varieties

Yield attributes grain and straw yield differed significantly by different varieties. Highest grain and straw yield was recorded with Pusa Sugandha 5 (42.74 and 56.66 q/ha) which was significantly superior over rest of the varieties. Increase in grain yield with Pusa Sugandha 5 was 4.70, 9.64 and 66.49% higher over Pusa Sugandha 4, Pusa Basmati 1 and Taraori Basmati, respectively.

Plant dry weight is also an important pre-requisite for higher yield as it signifies photosynthetic ability of the crop. Highest values of plant dry weight (755.55 g) was recorded with Pusa Sugandha 5 which showed significantly higher values over other varieties. Higher grain yield with Pusa Sugandha 5 was mainly due to significantly higher values of number of tillers (273.33/m^2), length of the panicle (24.25 cm), number of grains/panicle (90.11) and test weight

Table 1 Yield attributes and yield of rice as affected by establishment methods and varieties (pooled data of 2 years)

Treatment	No. of tillers/m^2	Length of panicle (cm)	No. of grains/panicle	Plant dry weight (g/m^2)	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)
Crop establishment methods							
Direct seeding	243.91	22.68	67.46	673.25	19.05	32.48	42.66
Drum seeding	254.91	23.77	84.41	737.91	19.82	38.50	51.67
Transplanting	262.16	23.63	95.25	777.66	20.41	40.18	53.04
CD (P=0.05)	9.36	0.49	3.71	16.10	0.062	0.88	4.35
Varieties							
Taraori Basmati	227.66	22.73	73.66	700.54	19.80	25.67	38.24
Pusa Basmati 1	251.11	23.03	79.72	725.67	19.57	38.98	49.87
Pusa Sugandha 4	262.55	23.44	86.00	736.68	19.65	40.82	52.12
Pusa Sugandha 5	273.33	24.25	90.11	755.55	20.09	42.74	56.66
CD (P=0.05)	6.87	0.24	2.46	10.50	0.068	0.90	5.30

Table 2 Economics of different treatment combinations (pooled data of 2 years)

Treatment combinations	Cost of cultivation (₹/ha)	Gross income (₹/ha)			Net profit (₹/ha)	B: C
		Cost of grain	Cost of straw	Total		
Dry seeding + Taraori Basmati	25 228.00	44 224.00	520.15	44 744.15	19 516.15	0.77
Dry seeding + Pusa Basmati 1	25 230.00	53 593.60	660.85	54 254.45	29 024.45	1.15
Dry seeding + Pusa Sugandha 4	25 230.00	58 880.00	685.70	59 565.70	34 335.70	1.36
Dry seeding + Pusa Sugandha 5	25 234.00	61 440.00	711.25	62 151.25	36 917.25	1.46
Drum seeding + Taraori Basmati	24 865.00	33 856.00	642.95	34 498.95	9 633.95	0.39
Drum seeding + Pusa Basmati 1	24 867.00	66 329.60	776.00	67 105.60	42 238.60	1.70
Drum seeding + Pusa Sugandha 4	24 867.00	72 396.80	817.75	73 214.55	48 347.55	1.94
Drum seeding + Pusa Sugandha 5	24 871.00	73 126.40	863.65	73 990.05	49 119.05	1.97
Transplanting + Taraori Basmati	30 588.00	47 040.00	647.85	47 687.85	17 099.85	0.56
Transplanting + Pusa Basmati 1	30 590.00	69 056.00	807.55	69 863.55	39 273.55	1.28
Transplanting + Pusa Sugandha 4	30 590.00	73 177.60	842.05	74 019.65	43 429.65	1.42
Transplanting + Pusa Sugandha 5	30 594.00	76 992.00	885.00	77 877.00	47 283.00	1.55

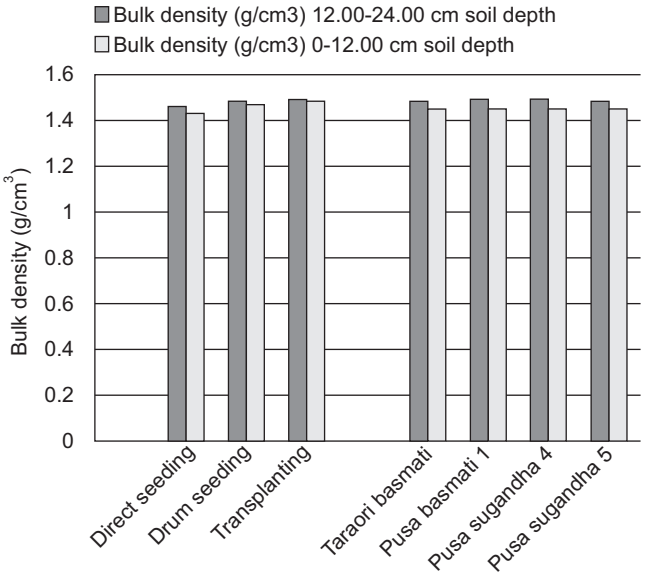

Fig 1 Bulk density (g/cm^3) as affected by establishment methods and varieties.

(20.09 g) over Pusa Sugandha 4, Pusa Basmati 1 and Taraori Basmati. These results are in conformity to the findings of Atlin *et al.* (2004).

Economics

The highest cost of cultivation was obtained with transplanting method with any variety under test. In combination of establishment method and varieties highest cost of cultivation was recorded with transplanting with variety Pusa Sugandha 5 (₹ 30 594.00). This was mainly due to cost of puddling and transplanting, while lowest cost of cultivation was incurred under drum seeding with variety Taraori Basmati (₹ 24 865.00). Highest values of gross return was recorded under transplanting with variety Pusa Sugandha 5 (₹ 77 877.00) followed by transplanting with Pusa Sugandha 4 however, highest net profit was obtained under drum seeding with Pusa Sugandha 5 (₹ 49 119.05) followed by drum seeding with variety Pusa Sugandha 4 (₹ 48 347.55) (Table 2). The highest benefit : cost ratio is computed with drum seeding with variety Pusa Sugandha 5 (1.97). This was mainly due to higher yield with low cost of cultivation was recorded under this treatment. Similar results have also been reported by Singh (2002) and Singh *et al.* (2005).

Bulk density

Crop establishment methods influenced the bulk density, increasing soil depth increased the bulk density due to compactness at deeper layer. The lower values of bulk density was recorded with dry seeding at each depth (Fig 1). This was due to ploughing effect which improved the soil structure and decreased the soil compactness. Higher bulk density under transplanting and drum seeding is attributed to puddling process which increased the soil compactness. Various variety did not appreciably influenced bulk density.

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